

WRAP-UP
1986/87

Scientific Activities in Alberta, Statistics Wrap-Up 1986/87

Alberta
TECHNOLOGY, RESEARCH
AND TELECOMMUNICATIONS





Digitized by the Internet Archive
in 2016

https://archive.org/details/scientificactiv1986albe_0

PART ONE: ALBERTA FOCUS

Science activities in Alberta are funded by the provincial government, federal government, and industry. The provincial government is the largest funder (\$329 million in 1986/87) and promotes the broadest spectrum of scientific research and related activities. To execute its science agenda, the provincial government chiefly relied on universities, industry, hospitals, and the Alberta Research Council (ARC). Seventy cents of every science dollar was channeled to the non-government sectors of the province.

In contrast, Alberta industry expenditures on research and development (\$238 million) were in-house commitments. This suggests that the services, petroleum, and manufacturing industries have significant in-house science and technology establishments. The federal government also has significant science establishments in Alberta, \$101 million of the \$166 million spent on science in Alberta was intramural (in-house) expenditure. The

Universities of Alberta and Calgary were the largest non-government participants in the federal science agenda in 1986-87.

Each of the funders has science mandates that involve the Alberta community and warrant a closer look.

PROVINCIAL GOVERNMENT

The government's science agenda is dominated by two areas, basic and clinical medical research and fossil fuel recovery and processing research and development. As shown in Table 1, each of these objectives claimed one quarter of the year's science expenditures. Major funding in these two areas is provided by endowments of the Heritage Savings Trust Fund administered by the Alberta Heritage Foundation for Medical Research (AHFMR) and the Alberta Oil Sands Technology and Research Authority (AOSTRA.) Table 2 matches funders with performers of the government's science activities.

TABLE 1
MAJOR OBJECTIVES OF ALBERTA GOVERNMENT
SCIENCE EXPENDITURES, 1986/87

OBJECTIVE	\$ IN MILLIONS	%
health	\$88.3	27
fossil fuel	82.5	25
manufacturing	55.6	17
agriculture	21.3	6.5
environment	19.6	6.0
culture, sports & recreation	16.8	5.0
other	45.2	14
total	\$329.4	100

HEALTH

AHFMR emphasizes the training of next generation medical researchers and enables experienced investigators to pursue promising lines of research into the causes of disease at the molecular level. As such, it supports a wide spectrum of health disciplines, such as biochemistry, immunology, and microbiology.

Most of its awards are to individuals and take the form of fellowships and scholarships, Heritage Medical Scientist and Clinical Investigator awards. AHFMR also makes institutional grants to accommodate planning and construction of research facilities such as the Heritage Medical Research buildings at the Universities of Calgary and Alberta. In 1986/87, AHFMR made 436 new awards

valued at \$12.7 million. Continuing awards and institutional grants brought the annual expenditure on medical research to \$56.9 million.

Universities are the principal performers of the Alberta health agenda. Virtually all AHFMR grants are awarded to university medical researchers. Sixty per cent of all provincial government funded university research is attributable to medical research.

Hospital-based clinical investigators carried out a sizable portion of the Alberta health research agenda. The Department of Hospitals and Medical Care funded \$18.7 million in medical research conducted by the hospitals primarily in applied heart disease research and applied cancer research.

TABLE 2
MAJOR FUNDING DEPARTMENTS AND AGENCIES OF ALBERTA
GOVERNMENT SCIENCE AGENDA AND PERFORMING SECTOR, 1986/87

FUNDING DEPARTMENT OR AGENCY	PERFORMER INTERNAL	INDUSTRY	UNIVERSITY (\$ in '000s)	HOSPITALS	ARC	OTHER	TOTAL
Agriculture	10,788	813	2,320	—	704	2,528	17,153
Agriculture Research Trust	29	—	381	—	—	—	410
AHFMR	—	—	54,304	—	—	2,626	56,930
Community & Occupational Health	814	13	159	—	—	—	986
Hospitals & Medical Care	2,154	84	3,625	18,566	—	261	24,690
Mental Health Research Fund	—	—	676	24	—	—	700
Culture	15,930	2,646	—	—	—	1,022	19,598
Municipal Affairs	2,573	939	10	—	—	22	3,544
Energy	771	4,160	962	—	1,775	249	7,917
AOSTRA	3,725	64,886	3,929	—	5,349	1,028	78,917
Environment	9,837	3,924	488	—	1,046	1,189	16,484
Environmental Centre	11,670	—	—	—	—	42	11,712
Environmental Council	1,245	—	—	—	—	—	1,245
Forestry, Lands, & Wildlife	6,146	1,024	405	—	1,185	—	8,760
Technology, Research & Telecom	156	9,180	22,269	—	23,357	130	55,092
Economic Development & Trade	3,811	1,805	21	—	17	86	5,740
Transportation	3,827	470	310	—	332	302	5,241
Treasury (Statistics Bureau)	2,267	—	—	—	—	—	2,267
Other	7,729	1,362	1,324	120	—	1,437	11,972
Total	83,472	91,306	91,183	18,710	33,765	10,922	329,358

FOSSIL FUEL

The central activity of the government's energy agenda is oil sands research, particularly the development and piloting of insitu recovery processes. Such projects claimed 60 per cent of AOSTRA's 1986/87 expenditures. AOSTRA's research activities are typically multi-year projects embracing a range of innovation activities from fundamental, basic research to demonstration projects of new technologies and processes. The major program areas include insitu recovery, underground access technology, bitumen up-grading, mining and extraction techniques, and enhanced recovery of conventional oil. The second aspect of the government's fossil fuels science program is coal technologies. It is funded by the Alberta Energy/Office of Coal Research and Technology which directed \$7 million in research activities in 1986/87.

Petroleum and engineering companies are the major performers of fossil fuels research and development. Industry received about \$65 million (80 per cent) of AOSTRA's 1986/87 research expenditures. Of the \$91 million directed to industry for all government science activities, 70 per cent was concentrated on oil sands and heavy oil-related research. Coal-related research is also largely performed by industry, in this year valued at \$4 million.

Other research organizations participate in oil sands research programs. University researchers worked on 41 projects valued at \$2.8 million. Thirty of these projects were assigned to the local universities. The Alberta Research Council received \$5.3 million from AOSTRA under a joint oil sands and hydrocarbon recovery program. The Council is also a talent pool for coal research. Its coal and hydrocarbon processing department serves the science objectives of the Office of Coal Research and Technology, Alberta Energy, and the federal organization, CANMET.

MANUFACTURING

A significant element of the government's science agenda is the development of local science and technology capabilities, particularly in applications of new technology to innovative products and manufacturing processes. Government funding of these endeavors is channeled principally through the Department of Technology, Research and Telecommunications (TR & T). This amounted to \$55 million in the 1986/87 period. Approximately half was allocated to the Universities of Alberta and Calgary in support of the industry-university technology centres: Alberta Telecommunications Research Centre, Alberta Micro-electronics Centre, Centre for Frontier Engineering Research, and Supercomputing Services. The centres are a pool of "tech know-how" that can be accessed by local firms as affiliates or contractors for services.

The Alberta Laser Institute functions in similar fashion to the centres but it is not affiliated with a university. Other industry performers of the technology development mandate include Chembiomed, a biopharmaceuticals enterprise; and Myrias which is pioneering parallel processing computers. A variety of technology applications are promoted under the Technology Commercialization Fund. In 1986/87, \$2.5 million was available to industry.

The Alberta Research Council's government grant, \$23 million via TR&T, enabled industrial research and development services in several technologies. The largest in size if not in investment dollars is its biotechnology facility. A pilot and scale-up processing plant with professional staff aids companies that are developing new agricultural and animal health products. The Electronics Test Centre serves Western Canada's electronics equipment and components manufacturers. The Council's Advanced Technologies Department is part of a Canadian Consortium, CARNPER, pursuing artificial intelligence and robotics technologies.

IN-HOUSE SCIENCE ACTIVITIES

Government departments or agencies are the principal performers of the public science agenda in culture, environment, and agriculture. The social science activities of *Alberta Culture and Multiculturalism* are embodied in the archaeological survey, archives facility, historic sites program, and museum services, e.g., the Tyrell Museum of Paleontology, Provincial Museum of Alberta in Edmonton, and Reynolds Alberta Museum of Transportation. The Tyrell and Provincial museums had active natural sciences research programs in 1986/87. Given the concrete expression of their science activities, the reliance on in-house science personnel and laboratories for 80 per cent of its yearly science expenditures is understandable.

The *Alberta Environmental Centre* is the primary source of the Provincial Government research, technology development, and testing services on environmental matters. In addition to its own research agenda, it serves all government departments that identify problems requiring investigation. In 1986/87, the Centre performed research studies

for Energy, Community and Occupational Health, Special Waste Management Corporation, Forestry, Lands and Wildlife. The Centre's \$11 million allocation supported six research areas: pest management related to agriculture; water and waste water; environmental toxicology concerning petrochemical and other industrial pollutants; land reclamation using native plant species; waste management relating to stabilizing, solidifying wastes; and living natural resources - fish and wildlife management.

Alberta Agriculture operates a number of research facilities across the province such as the Food Processing Development Centre at Leduc, Special Crops and Horticultural Research Centre at Brooks, and Soil and Animal Nutrition Laboratory at Edmonton. The research centres cover an array of agricultural issues: crop and livestock production, water use efficiency and irrigation systems, plant diseases and insect pests, soil and feed testing, food and food quality analyses, and veterinary diagnostics.

Approximately \$10.8 million of its science expenditures for 1986/87 supported the operations of research centres.

FEDERAL GOVERNMENT IN ALBERTA

A majority of federal science expenditures are directed to its own departments and agencies, thus, its major spending departments are the major performers of science activities. The reliance on government research organizations is most notable in the departments of agriculture, environment, and fisheries and oceans - major science spending departments that absorbed 90 per cent of their science dollars in 1986/87.

However, departments and their intramural science agendas are decentralized. For example, Agriculture Canada expenditures in Alberta were \$39 million this year. Federal establishments such as the Animal Disease Research Institute at Lethbridge and Northern Forest Research Centre at Edmonton performed nearly the total

science program in Alberta, consuming \$38 of the \$39 million. In effect, the federal government research installations in Alberta enlarge the pool of science and technology capabilities rather than the pool of science dollars available to local industry and university sectors.

IN-HOUSE

Table 3 highlights the major performers/funders of the federal science agenda and the distribution of these resources among the western provinces and Ontario and Quebec. Note that in the federal scheme, agriculture and environment are public domain science and technology, i.e. they are intramural activities regardless of provincial location of the performing establishments.

TABLE 3
FEDERAL GOVERNMENT SPENDING ON NATURAL SCIENCES
AND ENGINEERING IN SELECTED PROVINCES, 1986/87

		EXPENDITURES IN MILLIONS BY PROVINCE						NC REGION
DEPARTMENT OR AGENCY		ALTA	BC	SASK	MAN	ONT	QUE	
RIE	external	3	15	2	3	58	119	5
NSERC	external	27	37	10	8	123	63	13
MRC	external	13	14	4	8	56	50	5
NRC	external	5	33	6	11	38	19	16
	internal	0	9	10	6	4	32	224
DEFENSE	external	2	4	0	4	26	10	34
	internal	13	10	0	0	26	42	22
EMR	external	3	4	3	2	16	28	9
	internal	21	8	3	0	2	8	186
AGRICULTURE	external	1	2	2	2	4	3	5
	internal	38	33	22	20	45	39	82
ENVIRONMENT	external	1	1	0	2	4	0	1
	internal	22	25	11	14	145	42	14

Looking at the Alberta profile of federal science activities, the local talent pool is enriched by scientific establishments of Defense, Energy, Mines and Resources (EMR), Agriculture, and Environment. Intramural Defense is characterized by the biochemical and medical defense research mandate of the Suffield operation. EMR is locally identified with the Institute for Sedimentary and Petroleum Geology, part of the Geologic Survey, and the CANMET laboratory for coal technology research. The chief activity of Agriculture Canada research organizations in Alberta is the food development program with a secondary program in silviculture. Rather than research and development, the Federal Environment groups in Alberta perform related science activities of the Atmospheric Environmental Service and conservation and environmental protection services.

Some of these federal activities augment provincial activities. EMR's coal research via CANMET adds to the local resources of the Office of Coal Research and Technology and Alberta Research Council. Federal conservation and environmental protection services complement research and development activities of the Alberta Environmental Centre.

INDUSTRY

The 1986/87 federal purse for non-government science performers in Alberta was enlarged mainly by Regional and Industrial Expansion (RIE), the Medical Research Council (MRC), and the Natural Sciences and Engineering Research Council (NSERC). Added to these are the external science expenditures by the National Research Council (NRC), Defense and EMR. These same departments and agencies channel federal science dollars to industry and university performers in the other provinces.

Federally funded industry science activities are typically natural sciences and engineering research and development grants and contracts. The major sources of industry research grants and contracts are RIE, Defense, and NRC. In 1986/87, industry grants and contracts were concentrated on defense related research as shown in Table 4. Of the total value of federal grants and contracts to industry for natural sciences research and development, 45 per cent or \$218 million was defense related.

TABLE 4
FEDERAL GRANTS AND CONTRACTS TO INDUSTRY FOR DEFENSE
RELATED AND NON-DEFENSE R & D BY LOCATION OF PERFORMER, 1986/87

SOURCE	TOTAL	QUE	ONT (\$ in millions)	NAT. CAP.	B C	ALTA
DEFENSE RELATED						
DI PP (RIE)	141.5	93.5	33.8	3.3	7.7	1.3
Defense	76.6	8.1	21.3	32.6	3.8	2.4
OTHER						
IRDP (RIE)	50.3	17.7	18.1	1.1	6.9	1.9
NRC	88.6	16.5	34.5	15.5	6.3	3.4
Other departments	122.5	25.5	33.4	28.4	11.5	4.9
Total	490.0	168.0	141.2	71.0	36.3	14.0

* includes: Industrial Research Assistance Program, Program for Industry-Laboratory Projects, other grants and contracts

The largest component of RIE is the Defense Industry Productivity Program (DIPP) which takes 70 per cent of the science monies available through the department. The Industrial Regional Development Program (IRDP) is the vehicle supporting a broad variety of industrial science and technology developments. By identifying the program source, a clearer picture emerges of RIE funded industry research. For example, Quebec industry harvested the largest pool of RIE grants and contracts for the year, \$119 million. Note from Table 4 that \$93.5 million was channeled through DIPP.

Defense extramural spending in combination with DIPP dominates the distribution of federal funds for industry research among the provinces. Industry located in the provinces given in Table 4 derived a significant portion of federal science funding from defense grants and contracts, ranging from 60 per cent in Quebec to 26 per cent in Alberta.

Clearly Quebec is the home of Canada's defense industry sector with 47 per cent of the dollar value of defense related contracts and grants won by its firms. Ontario based firms and National Capitol Region firms garnered about 40 per cent in dollar value of defense related contracts and grants. The balance was performed by Alberta companies (2 per cent valued at \$3.7 million) and British Columbia firms (5 per cent valued at \$11.5 million)

Regarding non-defense industry research, Alberta enterprises attracted a larger portion of available federal science dollars, \$10.2 million or about 4 per cent. The single largest source of Alberta industry support were the NRC programs as was the case for Ontario and National Capitol businesses. Of the provinces where NRC reported extramural expenditures, in Quebec, Ontario, and Alberta the majority of external research was performed by local companies. However, in British Columbia only \$6.3 million of \$33 million of external science funding was directed toward local industry; in Manitoba only \$2 million of \$11 million was consumed by industry.

The non-defense external federal science agenda is more diffuse in its orientation and industry/province distribution than the defense program. Ontario industry captured 32 per cent of the available dollars and led all other provinces. With Quebec and the National Capitol Region, the trio accounted for 70 per cent of industrial research grants' and contracts' value. This is less skewed than the defense related pattern.

UNIVERSITIES

Federally funded university research relies on the awards of three granting councils: MRC which dispersed \$151 million, NSERC which allocated \$259 million, and the Social Sciences and Humanities Research Council (SSHRC) which granted \$34 million to University scientists in 1986/87. Table 5 shows the provincial dispersion of granting councils and other federal research awards to universities.

**TABLE 5
FEDERALLY FUNDED UNIVERSITY RESEARCH
BY SOURCE AND PROVINCIAL LOCATION
OF THE UNIVERSITIES, 1986/87**

PROVINCE	NSERC	MRC	SSHRC	OTHERS	TOTAL
			(\$ in millions)		
Alberta	25	13	1	7	46
Ontario	99	54	13	42	208
National Capitol Region	11	4	1	6	22
Quebec	55	48	12	27	142
British Columbia	33	13	4	36	86
Saskatchewan	9	4	0	7	20
Manitoba	7	8	1	6	22
New Brunswick	5	0	1	2	8
Nova Scotia	9	5	1	5	20
Newfoundland	6	2	0	1	9

The most identifiable complement to Provincial Government sponsored research is medical research. Given the Alberta commitment of \$56 million to university medical research, federal funding via MRC added about 23 per cent to the 1986/87 value. The other province that committed major funding to medical research was Ontario. Its universities received 36 per cent of available MRC dollars to supplement their activities compared to 8.6 per cent received by the Universities of Alberta and Calgary.

In the aggregate, Alberta universities garnered 8 per cent of the total external federal science expenditures to universities.

INDUSTRY IN ALBERTA

In 1986, 3,414 companies in Canada reported on their in-house research and development activities and expenditures. Among them were 354 Alberta enterprises. Although companies were asked to describe all of their research activities, including externally funded research, most concentrated on internally funded projects. Thus, the information on industry research activities is less comprehensive than the federal or provincial government accounts of scientific expenditures.

SERVICES

The industrial sector captured in the 1986 survey committed \$3.8 billion to science and technology development. Alberta firms reported \$238 million in scientific research as shown in Table 6. The services sector was the strongest performer in Alberta, constituting about 40 per cent of the total expenditure. The services group embraces engineering and scientific services, computing services, utilities and electrical power services companies. Across Canada, the services sector was a major performer of energy related research, \$258 million of \$1,018 million total research expenditures. It is highly probable that a comparable portion of the Alberta services sector research and development dollars were energy/fossil fuels related.

Note that the Alberta service companies' research and development activities were more capital intensive than the national reports for the sector, 40 per cent capital research and development among Alberta firms compared to 14 per cent nationally. In this context, capital expenditure refers to major research equipment purchases or construction of research laboratories.

TABLE 6
INDUSTRIAL R & D PERFORMED IN CANADA AND ALBERTA
BY MAJOR INDUSTRY GROUPS, 1986

GROUP	CANADA R & D			ALBERTA R & D		
	CURRENT	CAPITOL (\$ in millions)	REPORTING UNITS	CURRENT	CAPITOL (\$ in millions)	REPORTING UNITS
services	841	177	1,554	59	39	190
manufacturing	2,372	352	1,804	80	17	131
crude petroleum & mining	78	8	56	39	4	33
Total	3,291	537	3,414	178	60	354

* includes required petroleum and coal products

MANUFACTURING

In terms of the Province's gross domestic product, manufacturing has declined during the 1980s. However, it's 1986 research expenditures represent an increase of \$26 million over 1985 expenditures. Note that its capital expenditures exceed the national proportion of capital to current expenditures, 17 per cent capital research expenditures in Alberta compared to 13 per cent nationally.

ENERGY

Crude petroleum, natural gas and mining businesses tend toward capital intensive research projects. An example of such projects are the AOSTRA underground access technology demonstration project. In 1986, the industry's research activities are not consistent with the historical trend. Capital research expenditures comprise 9 per cent of the sector total in Alberta and Canada.

Fossil fuels research is a composite of refined petroleum and coal products, crude petroleum and natural gas, and mining industries. This group generated \$241 million of research and development, of which \$184 million was

performed in Canada. Alberta firms were the leading performers, utilizing 47 per cent of the total purse.

PEOPLE

Current research expenditures include salaries of scientific staff and supplies, equipment consumed in their work. The Alberta industry research and development spending is skewed toward current expenditures, 75 per cent of the total expenditures. Thus, there is a strong reliance on in-house science and technology talent. The 354 firms collectively employed 2,315 research staff, of which 1,260 are professionals with university credentials. In a national context, the in-house research complement was 47,245 employees of which 24,530 were professionals

Table 7 relates the corps of researchers to industry sector and the provinces. Note that approximately half of the Alberta industrial research complement are employed by the services sector. The crude petroleum and mining sector employs 18 per cent of Alberta research talent. The manufacturing group employs 855 research scientists and auxiliary staff, most of whom work in the chemical based products sector.

TABLE 7
PROFESSIONALS AND AUXILIARY RESEARCH PERSONNEL EMPLOYED
BY INDUSTRY REPORTED BY INDUSTRY GROUP AND PROVINCE, 1986.

INDUSTRY GROUP	ALTA	BC	QUE	ONT	OTHERS	TOTAL
			(person years-rounded)			
mining & oil wells	420	95	155	170	70	910
chemical based	570	155	1,370	4,065	275	6,435
wood based	20	300	650	350	60	1,380
metals	30	50	630	1,145	50	1,905
machinery & transport equipment	65	130	3,410	3,735	310	7,650
electronics & electrical products	130	1,005	3,025	10,465	260	14,885
other manufacturing	40	95	210	505	50	900
services	1,040	1,455	2,640	6,980	1,065	13,180
Total	2,315	3,285	12,090	27,415	2,140	47,245

PART TWO: COMPARISONS OF PROVINCIAL GOVERNMENTS

Seven provinces participated in 1986/87 survey with Statistics Canada. Table 8 shows their science expenditures. The Ontario and Alberta Governments' level of funding in absolute terms vastly exceeds the other provinces. Indeed the collective spending of British Columbia, Saskatchewan, Manitoba, New Brunswick and Newfoundland does not equal either Ontario's or Alberta's support to science. In relative terms, the Alberta science expenditures represent 2.3 per cent of total government expenditures for 1986/87; Saskatchewan allocated 1.7 per cent of its expenditures to science activities; the remaining provinces spent about 1 per cent on science activities.

The provinces concentrated their funding on the natural sciences and engineering (NSE) generally dedicating 75 per cent of the available funds to this type of science. In Alberta, NSE activities received 86 cents of every science dollar. However, research and development spending varied considerably. In Alberta 74 per cent of all science dollars was earmarked for NSE research and development; the next in magnitude was Ontario which earmarked 44 per cent to natural sciences research and development.

TABLE 8
PROVINCIAL GOVERNMENT
EXPENDITURES ON SCIENCE, 1986/87

PROVINCE	(\$ in millions)			
	ALL SCIENCES	NSE TOTAL	NSE R & D	SSH
Ontario	347.1	248.2	151.5	99
Alberta	329.4	284.9	245.4	44.4
British Columbia	92.7	69.1	26.1	23.6
Saskatchewan	64.9	48.4	31	16.6
Manitoba	44.9	34	7.2	10.9
Newfoundland	25.3	16.5	.6	8.8
New Brunswick	—	19.7	8.6	—

Social Sciences and Humanities (SSH) research and related activities was predominantly an Ontario activity. It spent over twice as much on the social sciences as the second largest funder, the Alberta Government

WHAT IS FUNDED

An overview of the science agenda of the provincial governments is presented in Table 9. Industrial development was the universal priority, garnering the largest share of science funding in all provinces though it is most concentrated in New Brunswick. One notable difference among the provinces is health research which was identified only with Alberta and Ontario. As well, Alberta's emphasis on energy is exceptional among the provinces. With respect to social development, Alberta allocates the lowest percentage to this category which includes culture, sports and recreation, urban and regional studies.

While relative measures are useful for an overview, they can be misleading given the magnitude of differences between Ontario and Alberta support to science and the other provinces'. For example, in percentage terms Alberta's spending on social development was at the low end of the scale, however, in dollar terms Alberta's social development allocations were second to Ontario's. The actual expenditures shown in Table 10 also reveal significant differences in the provinces' science agendas with regard to industrial development, energy and environmental objectives.

Industrial development can be locally defined by the emphasis in Provincial Government expenditures. In Alberta, industrial development was largely synonymous with manufacturing; in British Columbia it was forestry; in Saskatchewan it was agriculture. In Ontario, it had a split identity between manufacturing and agriculture (largely food processing). Mineral exploration, recovery and

TABLE 9
OBJECTIVES OF SCIENCE EXPENDITURES OF PROVINCIAL GOVERNMENTS OF 1986/87

OBJECTIVES	PERCENTAGE OF TOTAL SCIENCE EXPENDITURES						
	ALTA	ONT	BC	SASK	MN	NB*	NFLD
advancements of science	3	9.4	>1	1.5	4.1	6	>1
energy	23.5	2.7	5.7	8	11.3	3.3	4.3
environment	6	13.5	9.4	4.8	16	7	4
health	26.8	22.2	6	14.7	5.7	>1	4.1
industrial development	27.2	31.6	48	44.2	38	78.3	45
social development	10.8	16.9	16.8	21.8	17	—	20.6
other	2.7	3.7	14	8	7.6	>1	21.7

* only NSE reported

TABLE 10
ACTUAL EXPENDITURES OF PROVINCIAL GOVERNMENTS BY OBJECTIVES, 1986/87

OBJECTIVE (\$ in thousands)	ALTA	ONT	BC	SASK	MAN	NB*	NFLD
Advancements of science	10,097	32,563	788	942	1,850	1,213	98
Health	88,314	77,195	5,558	9,562	2,543	150	1,046
Social development	35,555	58,554	15,643	14,186	7,603	738	5,237
Energy:	77,298	9,288	5,269	5,256	5,100	661	1,092
fossil fuels	73,245	—	3,231	4,999	492	277	272
conservation	240	5,403	—	—	4,447	170	430
hydro	—	119	1,025	—	170	5	—
renewable	88	2,695	13	—	40	209	390
other	3,725	1,071	1,000	257	51	—	—
Industrial development	89,454	109,720	44,439	28,723	17,021	15,462	11,355
agriculture	21,300	37,728	4,019	20,263	3,430	1,564	225
fisheries	664	2,403	1,752	323	1,080	3,357	664
forestry	5,149	9,023	27,417	305	2,520	2,619	2,375
manufacturing	55,630	34,226	2,826	4,759	4,773	2,775	—
minerals	475	14,556	6,322	1,225	4,026	4,869	5,571
other	6,236	11,784	1,243	1,848	1,192	278	2,520
Environment:	19,604	47,030	8,760	3,120	7,249	1,372	992
water	10,319	33,266	2,056	1,875	5,127	892	983
land	2,283	3,362	770	196	330	305	5
air	3,841	9,477	3,208	74	691	135	1
other	3,166	925	2,726	975	1,101	40	3
Other	9,301	12,738	13,116	5,171	3,441	156	5,501

* only NSE expenditures reported

processing absorbed the majority of industrial development funds for New Brunswick, Newfoundland and Manitoba.

With respect to **energy**, Alberta dominated this area of scientific activity with its oil sands and heavy oil recovery and processing research directed by AOSTRA. Part of Alberta's fossil fuel program centered on coal research and development. In the British Columbia context, coal was a more significant component of its fossil fuels agenda. The Ontario and Manitoba emphasis on conservation paralleled the federal government energy agenda.

Water/waste water treatment was the **environment priority** for six of the seven provinces. Only British Columbia targeted more dollars to air quality than to "clear cool water." Ontario made the largest investment in environmental research and related science activities of the provinces. With acid rain and Great Lakes pollution at its doorstep, their commitment of public dollars to environmental problems is not surprising.

Medical research and public health sciences were major areas of Alberta and Ontario government funding. 1986/87 expenditures of the other provinces did not approach the magnitude of Alberta and Ontario support to health research. It is noteworthy that the two provinces rely on hospitals and health organizations (some affiliated with

universities) to execute a significant portion of its medical science agenda. For this year, hospitals and health organizations in Ontario performed about \$19.8 million in basic and clinical research; in Alberta they performed \$18.5 million approximately.

Perhaps the most striking difference among the provinces' science agendas is the treatment of **basic scientific research** captured in this survey as advancement of science. Ontario exhibits a singular commitment to basic science, particularly in view of the even-handed treatment of the natural and social sciences. Approximately half (\$16.7 million) of the allocation to basic science is directed toward social sciences and humanities research. The most comparable investment in basic research is Alberta's which is directed wholly to the energy sector via AOSTRA and Energy funding.

SCIENCE PERFORMERS

All the provinces in the survey have invested in significant in-house science and technology capabilities as indicated by the value of scientific activities performed intramurally. Table 11 shows the actual in-house expenditures made by government departments and agencies in 1986/87. In relative terms, Newfoundland was most self-reliant, about

TABLE 11
PERFORMERS OF PROVINCIAL GOVERNMENT NATURAL SCIENCES AND
ENGINEERING ACTIVITIES AND DOLLAR VALUE OF THEIR 1986/87 WORK

PERFORMER	ONT	ALTA	BC	SASK (\$ in 000s)	MAN	N B	NFLD
Gov't labs & dept.	95,816	50,322	49,260	15,084	25,407	10,387	14,646
Provincial research organizations*	4,930	33,748	1,290	7,429	3,151	2,343	—
Universities	69,150	89,411	6,402	8,278	2,805	743	239
Hospitals & health organizations	19,770	18,479	403	364	—	64	120
Industry	27,160	84,983	8,260	8,553	1,313	5,832	1,036
Other	31,370	7,098	2,877	8,661	1,357	383	433
Total	248,196	284,923	69,127	48,369	34,033	19,752	16,474

* Such as the Alberta Research Council.

90 per cent of its natural sciences spending was absorbed by in-house staff and facilities. British Columbia and Manitoba showed a similar penchant for intramural spending; the government performed about 75 per cent of its natural sciences research and related activities. Alberta reported the lowest intramural share of expenditures, 17.5 per cent. Note the actual dollar value approximates British Columbia's intramural spending.

The role of industry in the provincial science agendas varied. Alberta channeled the largest amount to industry, approximately \$85 million representing 30 per cent of the total value of its natural sciences agenda in 1986/87. New Brunswick allocated a similar share to industry. Considerably fewer dollars were channeled to industry to British Columbia and Ontario, about 12 per cent of their expenditures.

Government science activities had significant impact on universities in Alberta and Ontario. Both provinces earmarked about 30 per cent of available natural science money for the university sector. In Alberta, these funds are concentrated in its two research universities. Hospitals and health organizations were also involved in executing the research agenda of these two provinces. The association of these organizations with medical research appears to be a unique characteristic of the Alberta and Ontario governments.

Five of the provinces designated the provincial research organization to perform some of their NSE research and related activities. The Alberta Research Council received a

singular level of government funding, \$33.7 million compared to next largest government expenditure of \$8.6 million for the Saskatchewan Research Council.

Statistics Canada publications used in the preparation of this report:

Industrial Research & Development Statistics 1986

R & D in the Petroleum Industries, 1988 Estimates (Science Statistics, Vol. 11, No. 11)

Science & Technology Activities of Provincial Governments 1979/80-1987/88

Federal Government Science Expenditures by Region 1981/82-1986/87

Federal Government Expenditures on Activities in Social Science: Humanities 1970/71-87/88

Staff and Expenditures of Federal Science Establishments 1986/87

Federal Government Expenditures on Activities in Natural Sciences & Engineering 1963/64-88/89

TRT publications used in the preparation of this report:

Scientific Activities of the Government of Alberta, 1986/87

Scientific Activities of the Government of Canada-Alberta Highlights 1986/87

Industry R & D 1986.

